JPRS 81160

29 June 1982

Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 150

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'HERALD' REPORT ON NUCLEAR FUEL RESEARCH

BK030955 Delhi NATIONAL HERALD in English 27 May 82 p 7

[V.H. Desai article: "How Well Can India Make N-Fuel?"]

[Excerpt] With the USA refusing to give nuclear fuel for the Tarapur plant, how is India placed to produce her own nuclear fuel? The answer is that we are really well placed. Indeed, we are among a select band of countries, and the only developing one among them, to have mastered the technology of the complete nuclear fuel cycle -- from uranium exploration, mining, extraction and conversion, fuel fabrication, heavy water production, reactors and reprocessing of the spent fuel. Nuclear fuel production is an important part of the cycle.

As a culmination of the research work done at the Bhabha Atomic Research Centre, the Nuclear Fuel Complex (NFC) was set up at Hyderabad in 1971.

This unit has got the facility to produce ceramic grade natural uranium fuel for Candu-type reactors as well as to process enriched uranium fuel for the Tarapur atomic power station.

Nuclear fuel has two basic components -- uranium oxide pellets and thin-walled zircaloy tubes. The different plants in NFC produce these two components starting right from the raw material.

On the uranium side, the "yellow cake" which is received from Jaduguda mines in Bihar is processed through a series of chemical operations for production of uranium oxide powder which is further processed by compaction and sintering for production of uranium oxide pellets.

On the zirconium side the zircon sand which is received from the Indian rare earths plant in Kerala is processed to produce zirconium oxide which is converted into zirconium sponge by magnesium reduction and further into zircaloy. The zircaloy ingots go through the process of extrusion for producing thin-walled fuel tubes and coolant tubes. The uranium oxide pellets are encased in zircaloy tubes and made into bundles which are used as basic fuel elements in nuclear reactors. The coolant tubes and calandria tube, which form the core of the nuclear reactor are also manufactured in NFC.

NFC is one of the very few places in the world where the entire process starting from raw material to assembly of fuel bundles is made under one roof. All the processes used in NFC are initially tried and perfected at the Bhabha Atomic Research Centre (BARC) and later transferred for production on an industrial scale.

NFC has also got a special materials plant where ultra high purity materials like tantolum, tin, indium, bismuth, gallium etc. are produced for application in the electronics industry.

As an important substitution measure adopted by the Government of India, NFC has gone into the production of seamless stainless steel and ball-bearing tubes. The seamless stainless steel tube plant has a capacity of 2,000 tonnes and can cater to a number of industries for fabrication of heat exchangers and other chemical operations. The ball-bearing tubes plant, with a capacity of 21,000 tonnes, can cater to the needs of the ball-bearing industry in the country.

With vast reserves of thorium, India has a good potential for developing fast breeder reactors which employ thorium as a basic raw material. In the fast breeder type of reactors, thorium oxide pellets are used as fertile material in the core of the reactor. A plant for fabricating components for the fast breeder test reactor coming up at Kalpakkam near Madras has also been set up at NFC.

To meet the needs of fuel for the new reactors coming up in the sixth plan, the capacity of fuel production at NFC is to be doubled to 200 tonnes per year for which additional facilities are coming up in the various fuel plants.

As a supplier of nuclear fuel, which is vital to the setting up of nuclear power reactors in different parts of the country, NFC occupies a unique position on the nuclear map of India.

Since radioactive materials like uranium are a health hazard the Department of Atomic Energy, which runs NFC, gives overriding priority to the conservation of the ecology of the areas. Prevention of air and water pollution are the paramount consideration.

There is a health physics division to monitor the pollution levels in air and water sources around nuclear installations like NFC and take preventive measures.

CSO: 5100/2187

MP QUESTIONS BENEFITS OF NUCLEAR WEAPONS DEVELOPMENT

Calcutta THE STATESMAN in English 13 May 82 p 8

[Article by Jaswant Singh]

[Text] IN 1964, with its nuclear tests at Lopnor, China announced its arrival in the nuclear world. For us in India, this news, though expected, had followed our traumatic military reverses of 1962. Since then, for almost two decades now, we have continued to live with the reality of a nuclear China. Recent missile tests by that country have also established its intercontinental launch abilities, a significant advance in the field. Yet, when the debate in India on our nuclear options hots up, it does not talk of China. Very largely, it confines itself to a deep concern about Pakistan's nuclear programmes.

Diverse views are held, antipodal in their extremes. Positions oscillate between India going nuclear being "immoral", and India not choosing to exercise this option also being "immoral". In this articulation of our concerns, we continue to discount the reality of a nuclear China. The nuclear might of neighbouring Soviet Union does not worry us and, despite the experience of the bewildering forays of U.S. Enterprise into the Bay of Bengal in the 70's, the nuclear arsenal of the USA does not cause us any concern either.

PAKISTAN

As in other matters, our worries seem to be centered on Pakistan. Ever since the late Zulfiqar Ali Bhutto spoke rhetorically of "eating grass" but "going nuclear", we have lived with that apprehension. Unattributable reports, most of them emanating from the West (this raises the very interesting question, what is India's own intelligence on the subject?), point towards the imminence of such a misadventure by our neighbour.

Two things need to be said here. One is a reality, however hard and unacceptable. Should Pakistan ever go nuclear, then there is no political leader (and I can conceive of no government in India) who would be able to restrain the groundswell of public opinion from launching the nation on this perilous, unchartered path. That is precisely why it is necessary to articulate this concern and to debate the issue. Secondly, we ought to accept that we just do not know enough about the subject. Most of our information is second-hand. Our reactions are not conclusions arrived at after a distilled analysis of the options available or the consequences of adopting one or another kind of policy posture. we alternate between grandiose sabre-rattling and "ahimsa".

We need to ask ourselves some searching questions. Would we still have nuclear aspirations if it were demonstrably established that there was just no possibility of Pakistan going nuclear? Or are we asking an independent nuclear status? If so, is it with a view to having a first-strike deterrence capability, or a reactive, residual, assured destructive ability giving us the "security" of deterrence? If the former, do we have the political will for it or are we, in the compelling phrase of McNamara, Bundy, Kennan and Smith, seeking the "acquisition of a weapons system solely for the purpose of preventing its use"?

Even that is subject to serious questioning. Because, of what relevance is the concept of '"deterrence" in our subcontinental context? Is it not axiomatic that such a restraint will apply only on the sane, the deterrable? On the other hand, if it is an independent nuclear capability that we seek, irrespective of what others (mainly Pakistan) may or may not do, have we sat down to analyse the diplomatic, economic, military and social consequences of it?

We have to begin at the beginning, for it is in that context that the relevance of our 1974 Pokharan blast lies. My view is that the Pokharan effort was an ad hoc, ill thought out, spur of the moment, act which has caused great harm to India and has not contributed a single positive gain to the country. It is my belief that, as a result of that needless explosion, India has lost a great deal. I am unable to comprehend even now as to what, if any, scientific advancement was achieved by that blast.

The ad hoc nature of the experiment is evident in our continuing to call it, misleadingly, a "peaceful" nuclear explosion. To be able to carry out the test in the summer of 1974, the decision to go ahead must have been taken in early 1972. That was a period of the culmination of the then Government's internal and external policies. Therefore, other than as an expression of a kind of national power symbol, I fail to find any other explanation for it. To call the test "peaceful", when until today we have not be able effectively to translate or even demonstrate any economic use for it, is to question everyone's intelligence. When the real advancement all over the world is in the field of electronics, it does not cloak our efforts to assert tangentially that Pokharan was an effort to keep up with the technological Jones'es.

As for diplomatic gains, if there were any, than they continue to remain pretty effectively disguised. It is open to serious questioning whether that blast helped us militarily or if it contributed in any manner either to our national security or served our national interests.

That egg, unfortunately, cannot now be unscrambled. So what are the options available to India? A study conducted has revealed that as percentage possibilities, after accounting for all relevant inputs, the chances of India going nuclear are as much as 53%, against 26% for Pakistan. Admittedly, this figure is as good or bad as any. It does, nevertheless, reflect the total capability of these two nations to adopt a nuclear course.

Before going any further, let me, very briefly, recount the possible compulsions for India embarking on this course. Such compulsions could cover within their ambit concepts like deterrence, the use of a nuclear weapon as part of the total defence arsenal, as an expression of India's "power" to influence and emphasize our regional, subcontinental, real-politik or even (though somewhat unconvincingly) our international status. And, finally, it could even serve as a reason from the purely internal national will or morale aspect. As an exercise towards the strengthening and advancement of a scientific, technological and and military momentum, the compulsions would be very difficult to bring under sharp focus.

QUESTIONS

What are some of the other question marks? These have now to be voiced, largely in order to create a concern as also to activate a debate. If ever we are called upon to decide, as a nation, we must know what we are doing. The very first query is whether our attempts at a nuclear cure are not worse than the ailment itself. Let me eleborate on this. We have blindly adopted the esoteric, nuclear mumbo-jumbo of the West, without pausing to relate it to the functional reality of this subcontinent. A colleague, in a highly perceptive remark, once observed: "Like China, India does not belong to the Third or any other world. It is a world of its own." Now, this is in fact not a boast. It is merely the recognition of a reality.

Of course, simultaneously, one has to concede that this whole convoluted nuclear question is an indication of the increasing complexity of conflicts between nation States as also of international relations. But for us the central question is largely derivative. Given a situation of economic (IMF, etc.) and armaments (Soviet arms, French aircraft, German subs, etc.) dependence, is an independent nuclear aspiration by India at all feasible? In an attempt to answer this as illustrative of what can be done, quite often China's case (as indeed that of France) is pointed out. Are these examples relevant? In finding an answer, the aspects of costs and technology acquire primacy. We have already accepted that ours is a dependent economy. When talking of nuclear weapons, one is not envisioning merely a Hiroshima-Nagasaki kind of a "crude" effort which could perhaps even be rolled out of the open doorway of a Boeing 737. We are envisaging a nuclear doctrine of "first strikes" and "deterrence".

India's nuclear capability would then comprise essentially our ability to hit targets of our choice first, or in retaliation. Assuming, hypothetically, that we cannot entirely discount China's existing nuclear ability, or Pakistan's aspirations, but are not taking into account the greater reality of nuclear super Powers (both in our ocean peripheries as also on the Asian landmass), then our effort becomes an attempt at joining the big league. We are talking in terms of at least an IRBM (Intermediate Range Ballistic Missile) capability. How else would you reach even the peripheries of our possible targets?

So we need a launch and a propulsion ability, command and control expertise, a surveillance system and a far more sophisticated intelligence than what we have now. There would then be the command and control costs. These are at the same time the most difficult and the most costly. The aspect of re-entry, even with Western technology, is quite often the most difficult aspect. With us the problems in this field appear almost insurmountable. If as a nation we are unable effectively to run our telephone systems, railways, buses or our public sector plants, how will we manage a nuclear arsenal?

DRAWBACK

This is not merely a facetiously expressed managerial concern. It translates itself into the totality of our cost concerns because of our proven inability to aggregate all the required environmental technology into the needed effort. From the Pokharan blast to the SLV-3, it has taken us more than seven years. That does not belittle the achievement of the space launch itself, significant as it continues to be. It is merely to point out the reality of the situation as it exists.

On the other hand, even if our aspirations are for the "crudest" of nuclear bombs, we would still need to deliver them in an effective kind of an aircraft which has speed, range, load capability, along with the ability to evade enemy interception. what do we have in that range and on whom are we dependent for it? Should, however, our efforts be in the field of rockets as delivery systems, then we would have to find answers to the problem of siting. If we site them on land, then we are faced with the possibility of their destruction by an enemy first strike even before we have got them off the ground. We really cannot consider the option of mounting them on our railway wagons and keep shunting then, in the care of Indian Railways. The USA thought of this option until a wag quipped, "What if the wagons get lost?" So one has to start thinking in terms of a SLBM or a Submarine Launched Ballistic Missile. Here we are faced with the reality of of only just having to think in terms of manufacturing our own submarines and that, too, with German assistance. This, very basically put across, is what is often referred to as one aspect of the "escalatory effect" of nuclear aspiration.

Let us then take straight costs. Needing more money to spend on our nuclear effort, assume, for arguments sake, that we increase our defence spending from the present level of 4% of our GNP to 6%. That would perhaps enable us to have roughly double the present defence budget. Even that would hardly suffice. A study, recently made by the Centre for Policy Research, points out that between 1955 and 1980, France spent approximately $20 billion to achieve an independent but limited nuclear capability. During its current modernization programme, it will now be spending another $60 billion to achieve a capability of around 200 strategic launchers by about 1995. After discounting lower labour costs but taking into consideration the factor of a relatively weak industrial and technical infrastructure, the study suggests that it would cost us around $75 billion over a period of 15 years.

We all know that exercising a nuclear option does not obviate the continued necessity for conventional weapons. If one were to add, to our assumed nuclear costs, the continuing, routine conventional weapons programmes during the next 15 years, we may require of our people to spend a sum of around $150 billion. Please note that one is not taking into consideration the further "escalatory" effect of "parity" attempting to move to "dominance" so that the "window of vulnerability" is closed. Even if the figures are open to serious questioning, the fact remains—as tellingly pointed out in the study—that with that sort of money, "at present levels and at a very rough estimate, we could acquire 750 very high performance fighter aircraft, almost a 100 naval warships and, possibily, around 20,000 AFV's and 4,000 helicopters".

Despite all this you could well argue that a great nation like ours could certainly put up with such costs. I am tempted to remark that, if we do decide that these costs are to be borne budgetarily, then without doubt the price shall have to be paid socially by us.

CSO: 5100/7099

INDIA

BRIEFS

URANIUM RECOVERY FROM COPPER--CALCUTTA, May 17 (UNI)--The Jaduguda-based Uranium Corporation of India Limited (UCIL) a Department of Atomic Energy enterprise, has drawn up an ambitious expansion programme to recover uranium from copper tailings, according to an official document available here. Under the programme, the present uranium recovery pilot plant at Rakha would be replaced by a full-fledged plant, the document said adding that a similar plant would be established at Masaboni. The decision to set up two full-fledged plants was taken after the functioning of the pilot plants was found satisfactory, the document said. The programme includes expansion of the existing milling plant at Jaduguda to treat ore from the Bhatin mine. The Atomic Mineral Division (AMD) has completed exploratory work for setting up new mining and milling facilities at Nar Apahar and Turumdih, the document said. The UCIL exceeded the target of producing by-products including copper concentrate, molybdenum concentrate and magnetite during the last financial year from the sale of which it earned Rs 56 lakhs. The corporation earned a profit of Rs 63.02 lakhs during the last financial year as against Rs 50.40 lakhs in the previous year, the document said. [New Delhi PATRIOT in English 18 May 82 p 8]

CSO: 5100/7100

BRIEFS

SEARCH FOR TEST SITE--The Pakistan Government's bid to carry out an experimental atomic explosion on the Chinese ranges in Tibet has run into a snag. According to sources, negotiations with the Chinese leadership are said to have floundered. Now the Pakistanis are said to be desperately trying to choose between the limited number of sites in their own country. Their search has acquired urgency especially since intelligence sources have confirmed that Pakistan will have capability of a delivery system in the form of F-16s by 1983. [New Delhi INDIA TODAY in English 15 Jun 82 p 8]

CSO: 5100/5672

BRIEFS

XIZANG LITHIUM--Beijing, 18 May--Preliminarily verified lithium deposits in China's Xizang region account for nearly 1/2 the world's total, it has been learned from the Ministry of Geology and Minerals, Lithium, a type of metal with the lightest specific gravity, low fusion point, high boiling point and very high heat conductivity and absorption capacity, can be used as fuel for hydrogen bombs, rockets, nuclear submarines and modern jet planes. It can be widely used in the metallurgical, chemical, glass, ceramics, electronics and atomic energy industries. Occupying a very important position in modern-day science and technology, it is dubbed a "metal upstart." As early as the mid-1950's, the geological department of our country discovered lithium in the sediments of many salt lakes in Xizang. Beginning in 1980, it started regular work in salt lakes in northern Xizang. Some 600 samples were collected, laboratory tested and analyzed, thereby verifying that these salt lakes contained very high lithium ores with high industrial value. Moreover, it is fairly easy to extract and purify them. [Text] [OW180547 Beijing XINHUA Domestic Service in Chinese 0010 GMT 18 May 82]

CSO: 5100/2187

ATOMIC POWER USE REDUCES ENVIRONMENTAL POLLUTION

LD211328 Moscow TASS in English 1209 GMT 21 May 82

[Text] Vilnius, 21 May, TASS -- Atomic power development contributes to reducing atmospheric pollution and to improving the ecological situation. This conclusion has been drawn by the participants in the conference of the specialists of the CMEA member states. The conference came to a close today in Vilnius, the capital of Lithuania (a Soviet Baltic republic). They discussed the problems of radiological safety in connection with the operation of atomic power stations. The conference was attended by delegations of Bulgaria, Hungary, the GDR, Cuba, Poland, Romania, the USSR, and Czechoslovakia, representatives of the International Atomic Energy Agency (IAEA) and the CMEA secretariat.

Ivan Morozov, vice chairman of the USSR State Committee for the Utilisation of Atomic Energy, commenting on the results of the conference, told a TASS correspondent that summed up were the results of scientific and technical cooperation of the countries of the socialist community in implementing a programme to enhance the radiological safety of atomic power stations both for the attending personnel and for the population and the environment. The basic directions of this cooperation for the nearest perspective have been outlined.

Atomic power development, Morozov emphasized, will allow making the natural environment much healthier. The analysis of the experience in the operation of atomic power stations in our countries has irrefutably proved the safety of nuclear power industry. This is also eloquently illustrated by the results of the systematic study of the radioactivity of Danube River and the Baltic Sea. There is no increase in radioactivity in the basins of these water reservoirs for a long time in spite of the functioning of several big atomic power stations.

Cooperation in enhancing the safety of atomic power stations is of great importance in view of an extensive program for the construction of atomic power stations in the Soviet Union and othe CMEA countries, Morozov said in conclusion.

CSO: 5100/2187

BRIEFS

CSSR, USSR NUCLEAR COOPERATION--Prague, 17 May--G. Husak, general secretary of the CPCZ Central Committee and president of the CSSR, today received A.K. Antonov, deputy chairman of the USSR Council of Ministers, who is leading the Soviet delegation at the session underway here of authorized representatives of the two countries' governments on the implementation of the program of cooperation between the USSR and the CSSR in the sphere of the development of nuclear power in the CSSR through 1990. During a friendly talk they discussed the results and prospects of Soviet-Czechoslovak cooperation in producing equipment for AES's. G. Husak stressed that close cooperation with the Soviet Union in the development of nuclear power for peaceful purposes is of exceptional importance for Czechoslovakia. He expressed confidence that long-term cooperation and joint work in this sphere will develop successfully in the future too. [TASS report] [Text] [PM240923 Moscow PRAVDA in Russian 18 May 82 p 4]

CSO; 5100/2187

NUCLEAR POWER DEVELOPMENTS, COOPERATION OUTLINED

Nuclear Power, Heating Plants

Warsaw PERSPEKTYWY in Polish 16 Apr 82 p 6

[Interview with engineer [Master of Science] Jan Kubit, plenipotentiary of the Minister of Mining and Power for nuclear power matters by Adam Hollanek, Sejm deputy: "Overdue Atoms"]

> [Text] With more than a 10-year delay, in respect to our needs, our government decided in January on the construction of the first Polish nuclear power plant. Why this happened and how the development of our nuclear energy will present itself is explained in our discussion with Master engineer Jan Kubit, plenipotentiary of the Minister of Mining and Power for nuclear power matters. Our interviewer, a Sejm deputy, has voiced for many years the necessity of making use in the power industry of "atoms in civilian life."

[Question] When did our energy crisis begin and what is it based on? After all, we have more coal than others.

[Answer] In the 1970's, an erroneous theory of economic planning was launched, which still lingers today: at first, it was the designing of facilities for the national economy whereas designing of the power industry was a secondary matter. This was as if though someone was creating an organism without taking into account whether he'll find the blood to give it life. As early as in the mid-70's, the economic organism started becoming deficient in this blood. Despite this, some national leaders publicly proclaimed the thesis about the surplus of our energy and about the need to use this power for export (for example, to Sweden by means of cables under the Baltic or to West Berlin). Therefore, the drastic energy restrictions have come as a great surprise to the public. Thoughtless delays in the development of the power industry can be made up, in my opinion, no sooner than in a matter of 15-20 years.

[Question] And are we now to take on, under such circumstances, the construction of the first nuclear power plant.

[Answer] It cannot be any other way. In the upcoming decade, we can achieve an increase in electric power production nearly exclusively from brown coal. However, the continued growth of the power industry from this source is limited by reasons of environmental protection and because of low industrial production of excavation machinery. It is not possible to even dream of oil and gas in terms of fuel for power plants. Nuclear fuel is the only remaining alternative. It [nuclear fuel] has no rational alternative under our conditions. An additional "threat" in this delayed matter is the fact that, in accordance with an agreement with the USSR, we are already receiving fuel which we, unfortunately, are not using. The amount of these supplies is equal to 18 million tons of hard coal. Our first nuclear power plant in Zarnowiec, in the voivodship of Gdansk, with 4 reactors with an output of 440 megawatts each will release 3 million tons of hard coal annually for export purposes. Its total power will amount to 1,760 Mw [megawatt], therefore, it will be greater than "Dolna Odra" or "Polaniec."

[Question] When will the current begin to flow from Zarnowiec and what will the future of nuclear power plants be in Poland?

[Answer] The first block of power should begin to move there at the turn of 1988-89. The next nuclear power plant will, most likely, be "Kujawy" which will already have reactors with a larger, thousand-megaton output. This construction will initiate a new phase of our nuclear power industry, which will be based on the application of, henceforth, typical, unified design solutions with four reactors of 1,000 hegawatts each. Similar giants (their total output being four thousand Mw) are already being installed in the USSR and in other CEMA countries.

[Question] How can our energy needs be summed up? How much of this energy will be needed by the economy up to, let us say, the year 2000?

[Answer] According to preliminary assessments, nuclear power plants with a total output of 25 thousand Mw ought to be installed in Poland to balance fuel-energy needs until the end of this century. This means twice as much as the present total operational output of the country's power industry. However, this does not seem realistic to me. Our true potential is estimated at about 15 thousand Mw which according to 1980 prices would cost about 600 million zlotys at least. Naturally, the public would have to accept such a great investment effort.

[Question] Why will the first power plant be situated in Zarnowiec?

[Answer] Because a pumped-storage hydroelectric power plant with a power of 680 Mw has been built there. Up to the time that the nuclear power plant is on line, it has to be supplied with power from the existing power main; for the time being power will be obtained from the "Dolna Odra" power plant and from Kozienice from which, however, an electrical supply line with a voltage of 400 kv has to be extended to Zarnowiec. The power losses as a result of this transmittal of energy amount to over 20 thousand tons of standard fuel (coal) annually. However, during peak periods, these losses and expenses pay off since the power, in short supply, flows from the pumped-storage power plant to the country's power main. The merging of this power plant with the nuclear power plant will increase the profitability of this kind of solution.

[Question] Where will we obtain the installations for this and the next nuclear power plants?

[Answer] From the Soviet Union. A working design is being developed there; that is where the technology and the construction of basic installations comes from. The USSR also assures us, as I have mentioned, supplies of nuclear fuel.

[Question] In many Western countries, especially in areas where nuclear power plants are to be built, the public is protesting against such structures. Thus, does a nuclear power plant expose the public to some sort of risk?

[Answer] This is where I must, regrettably reproach the press for informing about these matters incompetently. The well-known protests of Western society dealt with the building of nuclear power plants with considerably simpler construction than those in the Soviet Union. The other structures are cheaper and steam comes into the turbines, which power generating equipment, directly from nuclear power processes. The Soviet Union has dual systems of water circulation, thus the danger of direct "leaks" of radioactive substances from reactors is minimal. Besides, by strictly adhering to the safety code, which pertains to the operation of nuclear structures--those used in the West as well--there is no justification for fear. It is worth reminding here about the great superiority of nuclear power over the traditional one which pollutes and destroys man's natural environment. Nuclear power plants do not require extensive areas of land. They do not need space for fuel storage or buried waste. They do not pollute the air, with either dust or sulfur dioxide.

[Question] Does this mean that if nuclear power and heat generating plants were to be built in large urban centers instead of the traditional ones of the "Leg" type in Krakow or "Siekierki" in Warsaw, that there would not be as much pollution in these areas as there is presently?

[Answer] Indeed, besides nuclear power plants, a system of nuclear power and heat generating plants ought to be created. There are two methods of producing heat for large population centers poisoned by industrial fumes. The first method is the installation of low-pressure nuclear heating plants in the area of the urban centers themselves; such heating plants have reactors with a 300 to 500 Mw capacity. The second solution is based on the construction of nuclear power and heat generating plants with 1,000 Mw reactors and the use of heat-generating turbines. I will not go into detail here. In the summertime, these turbines supply current to the electric power main and heat for the city in the winter. Thus, the production of electric energy becomes a supplementary matter. Such a solution would be totally justifiable for Krakow, Gdansk, Slask as well as Warsaw. I am a fervent supporter of the development of the heating plant system based on nuclear fuel. Unfortunately, so far, such solutions are not being planned in the country, even though, they would be very useful.

[Question] How about in other CEMA countries?

[Answer] Heat-generating installations based on nuclear fuel are being built in the USSR and in Czechoslovakia where heat-generating reactors are also produced. We are behind in this respect as well. There are opportunities of establishing coproduction in this field as well; I feel, however, that this can be started no sooner than after 1990.

Soviet-Polish Cooperation, Coproduction

Warsaw KURIER POLSKI in Polish 23-25 April 82 p 3

[Article by Zenon Budny: "Atomic Debut"]

> [Text] For the time being, it is an empty field and Castle Hill [Zamkowa Gora] which is stripped of trees and rises nearly 100 meters above the surface of Jeziorno Zarnowieckie. This site has been waiting for its fate for 10 years. It is precisely here, at a distance of 22 km from Wejherowo and in the vicinity of the pumped-storage hydroelectric power plant "Zarnowiec" that the Polish debut in the nuclear power industry will take place. The ceremony of laying the cornerstone is planned here this month.

In August 1971, the state Presidium made a decision regarding the building of a nuclear power plant with a deadline of 1984-85 in which it should be placed in service. A year later, the location was determined to be in Zarnowiec. Then, a long interval took place--precisely speaking--10 wasted years. Successive deadlines for beginning the work passed while building preparations never went beyond the stage of paper agreements.

Why the delay? After all, the 1970's were a period of expanding investments and the forcing of industrial giants. Unfortunately, the nuclear power plant lost the duel with "Huta Katowice" [Katowice Steelworks], with "Berliet," "Fergusson," the small "Fiat" and color television. There was the preponderance of opinion that Poland, which is rich in coal, does not have to hurry with the nuclear power industry. The fact that a considerable portion of installations and fuel have to be imported, significantly dampened the enthusiasm of decision-makers. A total collapse of our power industry was necessary before it was obvious that things could not be put off any longer.

Scholars warned.... In numerous experts' reports and proposed programs, reference was made to the iron law of economics, which stipulates that a country which wants to develop normally, must double the power of its electric power plants every 10 years. It was to be expected that sooner or later, the country's energy needs would begin to grow at such a rate that traditional electric power plants would not be able to keep up with the generation of electricity. Experience has proven the validity of these predictions and very quickly--sooner than might have been expected.

Uranium V Coal

[Question] What considerations speak in favor of building an "atomic power plant"?

[Answer] Actually, we still regard ourselves as a major worldpower of coal production, however, it is an open secret that our mining industry is undergoing numerous difficulties; excavation costs are growing; it is necessary to excavate increasingly deeper coal beds. Coal has increased significantly in price on world markets and it is a known fact that at the present time, it is our main source of foreign-exchange, therefore, whether we want to or not, we must strive to maximize its export. In general, the fuel situation is bad because oil and gas prices have also risen to unprecedented levels. All of this together forecast the growing profitability of nuclear power plants.

The fact alone that the nuclear power plant in Zarnowiec will make it possible to save 3.5 million tons of coal annually, speaks in favor of its rapid construction. After all, the ability to become independent of transport is of no small significance either: here an entire year's supply of fuel can be delivered by several trucks while the traditional power plant entails a dozen or so trainloads of coal daily! The costs involved? A ton of nuclear fuel is, in truth, 30,000 times more expensive than a ton of coal, however, it supplies 100,000 times more power. No matter how one looks at it, it is profitable.

In addition to this, there are also immeasurable advantages, as for example, considerations involving the protection of the natural environment. When coal is burned, especially low grade coal, large amounts biologically harmful substances are emitted. Desulfurization of exhaust gases is very costly; the method of removing nitric oxide remains to be solved. On the other hand, a nuclear power plant does not pollute the air the slightest degree!

All of these arguments have settled the issue once and for all.

Before the Reactors Stop

In the middle of last year, deputies from the Sejm Commission for Mining and the Power Industry took an aggressive stand. A desideratum to the President of the Council of Ministers was passed in this regard demanding that quick decisions be made in respect to the building of a nuclear power plant and urging the necessity of taking on this venture. On 18 January of this year [1982], the State Presidium made things perfectly clear.

Shortly after, Zarnowiec was visited by the minister of Mining and the Power Industry, General Czeslaw Piotrowski. The venture gained momentum daily. Work brigades of the Gdynia Enterprises for Electric Power Plant Construction and the Industry of "Energoblok-Wybrzeze" have already moved into the 200-hectare area of the future power plant by carrying out ground-levelling operations. It will be necessary to move over 25 million cubic meters of earth by, among other things, levelling off Zamkowa Gora and filling up about 40 hectares of the lake water area.

The first in line will be preparations for the building of facilities: it will be necessary to build access roads, railroad side lines, a water treatment station, a sewage treatment plant, a pumping station, etc. The northern section of "Zarnowiec Lake" will be blocked by a dam while a canal, about 120 meters in width, will run along the eastern shore to bring in and carry off water for cooling.

The construction of the power plant in Zarnowiec will cost about 45 billion zlotys. This is a lot; an awful lot. However, this expense will be spread over a period of many years. Two blocks of 440 megawatts each will be ready for use in 1988 at the earliest and most likely, a year later.

Without Fear

It is not just recently that we have been reading world news reports about protests on the part of nuclear plant opponents in, among others, Austria, Sweden, FRG, and many other countries. Their concern is for the threat to safety; a vision of nuclear annihilation which can be caused by pure accident. Now, in connection with the construction in Zarnowiec, this is becoming a live issue in our country as well, therefore, it is worth clarifying. Does a nuclear power plant really present any kind of danger to the people and the environment?

Experts do not harbor any fears. A reactor cannot, under any circumstances, become a nuclear bomb; this is a physical impossibility. Therefore, the so-called, Hiroshima complex has no justification here, whatsoever. A remote possibility exists that the cooling system pipeline could break or that the core will succumb to melting and that radioactive substances could escape into the environment. However, this is only a theoretical possibility. Reactors are equipped with numerous, independent of each other and automatically activated backup cooling systems. If only one of these systems works, then the core will always be cooled and cannot melt. Even if all the systems were to fail at once, the radioactive substances would still not escape into the environment because the entire reactor is sealed within a leak-proof protective casing--a reinforced-concrete or steel shielding which is capable of withstanding a pressure of several thousand atmospheres. The chance of failure is, therefore, nearly nonexistent.

We have to admit that scientists have a truly crowning argument up their sleeve in the defense of their reasoning: thus during the last 2 years the nuclear power industry has not had one fatal accident worldwide in a power plant reactor.

How do things look as far as plans for Zarnowiec are concerned? This will be a thermal type power plant, with enriched uranium, Type WWER-440, Soviet reactors will be used here. They are equipped with the newest safety systems and placed in special casings with sprinkling systems and water condensors.

Where safety concerns enter into play, there is no room for any kind of doubts or ambiguity. Maximum caution is the obligation of designers. That is why, extremely thorough studies of hydrogeological, geological, meteorological, etc., conditions have been conducted in the region of Zarnowiec. A model of the lake was built in the laboratory and a study was made of the methods of distributing the warm stream in the reservoir in such a way so as not to disturb the thermal equilibrium of the water area. Seismological tests were even conducted, even though underground tremors are not registered in this area but...just in case. The system of radiological protection was worked out point by point. A so-called, sealed or protective zone was created around the power generating plant.

Among the residents of Wejherowo and surrounding areas, the nuclear power plant is, of course, the number one topic of discussion. However, one does not hear of anyone in this area who would have feelings of apprehension about this investment venture. From Kartoszyn, a village situated at the foot of Zamkowa Gora, several farmers have moved away, not from fear of a nuclear disaster but simply because their land was situated in the area of the fiture capital construction. There are people still living on eight farms but they too will move any day now. In any case, the land will not go to waste--300 thousand cubic meters of rich topsoil, taken off during ground-levelling operations will be utilized elsewhere.

And what about waste from the power plant? There will not be much of it but regardless of the amount, such refuse cannot be thrown out onto the dump pile or into the nearest pond.... The safest depository for radioactive waste are deep, abandoned salt mine pits. It is in such underground chambers that unsafe waste material will be stored.

From Domestic Factories

If public safety and that of the environment do not raise any concern, then there exist real reasons for concern of another kind: will not this investment venture make us dependent on importand will it not create an avalanche of foreign currency expenses?

Fifth percent of the power plant in Zarnowiec will be equipped with Polish installations. Fuel will be supplied by the USSR. But we are also conducting our own exploratory search for uranium with the hope that it will be successful.

In 1979, a coproducer agreement was signed by CEMA countries comprised of multilateral specialization and coproduction as well as mutual deliveries of equipment for nuclear power plants. This agreement defines the range of products and delivery deadlines. A portion of these tasks has been assumed by Polish industry. Such basic installations as pressure stabilizers, steam producing equipment, turbines, selected fixture elements, control-measuring device systems, backup generating units and others are produced or will be produced domestically both for domestic needs as well as for export purposes. Such well-known plants as Rafako-Raciborz, Fakop-Sosnowiec, Chemar-Kielce, Metalchem-Opole, Zgoda-Swietochlowice, Konstal-Chorzow and many others are involved in their production.

Therefore, we are not entirely condemned to import and owing to the reciprocal exchange [of equipment], foreign-exchange expenses should not be heavy. However, there does exist an indispensable condition: the high quality of this product. In the construction of installations for nuclear power plants, there can be no talk of any kind of defects or incomplete work. This awareness must accompany all manufacturers from the initial moment of the nuclear debut.

9853
CSO: 5100/3020

CASTRO MADERO ON RIGHT TO DEVELOP NUCLEAR SUBMARINES

PY120243 Buenos Aires TELAM in Spanish 1720 GMT 11 Jun 82

[Text] Buenos Aires, 11 Jun (TELAM)--Vice Adm Carlos Castro Madero, chairman of the National Atomic Energy Commission [CNEA], stated today that because of the use of nuclear energy by Great Britain for military purposes, Argentina will be free in the future to develop a nuclear submarine without violating any previous commitments. The CNEA chairman made these remarks to Radio Rivadavia from Vienna, where he is participating in the meeting of the International Atomic Energy Agency [IAEA].

He added: I asked and demanded from the IAEA a decision on whether it considers legal the use of nuclear submarines by a nuclear power against a nonnuclear country, a country which has everything under safeguards, which has fulfilled all its commitments not to use atomic energy for military purposes. Therefore, he added, in view of the profound inequality in the conflict, as of now, in the future, my government reserves for itself the right to also develop the euphemistically so-called nonproscribed nuclear activities.

Castro Madero added that this does not mean that Argentina is going to begin the production of nuclear weapons. I explained, he said, that it has nothing to do with nuclear explosives, but in this particular case, the development of a nuclear powered submarine. I presented the problem in the sense that the line which divides peaceful use from military use has been moved and it is no longer well-defined now.

Asked about the impact of his warning on countries which deal with the issue of nuclear energy, he stated that the first reaction was of support from the Latin American group. They demanded that my declaration be declared an official document.

He added: I noted great concern in many highly industrialized nonnuclear countries which really see the danger. The director general has viewed the subject as one of great importance and decided to engage immediately in a study to give me a clear answer to all the problems I presented.

Castro Madero concluded that the Argentine position has been very clear: and I believe that this is going to force the IAEA to review many ideas.

CSO: 5100/2189

BRIEFS

BUDGET CUT AFFECTS--Mexico City, 19 May (NOTIMEX)--The official spokesman for the Federal Electricity Commission, Eduardo Betancourt, reported today that budget cuts for some government projects will not affect work at the Laguna Verde nuclear plant. Betancourt said the first unit at Laguna Verde will begin operation in mid-1983. The plant is now 73-percent complete and 6,000 workers are working daily on it. Betancourt's statement refutes reports to the effect that Laguna Verde would be left unfinished because of budget cuts. It also refutes an international news agency report to this effect. [Excerpt] [FL200018 Mexico City NOTIMEX in Spanish 2350 GMT 19 May 82]

CSO: 5100/2187

ISRAEL

SOURCES VIEW PAKISTANI, IRAQI NUCLEAR CAPABILITY

TA271912 Jerusalem Domestic Television Service in Hebrew 1815 GMT 27 May 82

[Text] Reliable Western sources have told our defense affairs correspondent Ron Ben-Yishay that Pakistan has reached the stage where it can conduct a nuclear test any time it wants to. If it carries out a successful nuclear test Pakistan will join the group of countries enjoying a nuclear-military capability, such as India.

However, unlike Pakistan, Iraq has so far failed in its attempts to rebuild the nuclear reactor near Baghdad that was destroyed in the Israeli Air Force raid a year ago. Ever since then, Iraq has been trying to renew its nuclear cooperation agreement with France but so far President Mitterrand has refused to sell Iraq enriched uranium suitable for the production of a nuclear bomb. The negotiations between the Governments of France and Iraq over this continues, according to the sources.

Our correspondent reports that since the nuclear reactor was destroyed on the eve of the Festival of the Tabernacles last year the installation has remained completely paralyzed and no one is working there. The Iraqis are now trying to promote their nuclear bomb plan by hiring scientists from the United States and Western Europe.

Our correspondent points out that the head of the IDF intelligence branch, Maj Gen Yehoshu'a Sagi, said in a newspaper interview some time ago that the attack on the Iraqi nuclear reactor did not eliminate the nuclear danger to Israel, but merely postponed it to the 1990's. He added Israel faces a nuclear danger as long as there is an infrastructure of nuclear scientists and researchers in Arab countries.

CSO: 5100/2187

ISRAEL

NUCLEAR ENERGY DEVELOPMENT ISSUES DISCUSSED

Jerusalem INNOVATION in English No 78, May 82 pp 1-2

[Text] The construction of a nuclear electric generating facility, somewhere in Israel, has been on the agenda for more than two decades. Even before the oil price crisis, imposed upon the world by the OPEC cartel, many of this country's economic and scientific leaders were on the record as favoring the construction of at least one atomic power plant.

The matter again was brought to the public's attention by recent statements by the Minister of Energy and Infrastructure, that the acquisition of such a station now seems more practical, than in the past. Negotiations are said to be in progress with several potential suppliers.

That Israel has not yet embarked on such a project is due to several causes. One of those is political: every government here has refused to acceed to the international treaty against the proliferation of nuclear arms. Israel has absolutely no confidence in the International Atomic Energy Agency's ability to monitor that treaty's implementation, and cannot agree to make its facilities accessible to representatives of an organization that is largely under the control of its sworn enemies.

However, it must be stressed that this stand is not motivated by any opposition to the non-proliferation treaty's declared objectives: Israel has long been on the record against the use of nuclear arms and pledged not to be the first to introduce such weapons to the Middle East. Notwithstanding frequent rumors, reported in the world press at the likely instigation of hostile sources, there is no hard evidence at all that practice on this point here varies from that principle.

Another issue is that of security. In Israel, nuclear power raises more questions than elsewhere: here accident is not the only source of danger. The country has been at war for more than three decades, most of its neighbors refuse even to think of peace and international terror organizations want to destroy it. What would happen if a reactor were bombed from the air, or attacked by terrorists is here a very immediate concern.

There also have been some weighty practical problems. One of those is price: Israel cannot lightly undertake the construction of a facility which will cost upwards of a billion dollars. Foreign aid, which could help overcome this difficulty, has not been forthcoming until now.

Another question, which time and again delayed proposals for a nuclear power station, has been the lack of a suitable site: the sea shore location, essential because of the need for massive quantities of cooling water, have been found eminently unsatisfactory.

Geologists were the first to point out the difficulty. Their research showed that the area experiences significant earth quake activity: large parts of the ancient town of Caesarea now are deep below the surface of the Mediterranean, while sea shore hills far above the water show evidence of having been submerged within the last few centuries or millenia. Quite obviously, an atomic reactor must not be placed in such a volatile environment.

The interrelated question of plant location and cooling water may now be nearing a solution. Construction of a Mediterranean–Dead Sea canal during the 1980s (see *INNOVATION 62,* January 1981) will bring a large volume of such water to suitable areas in the Northern Negev and in the Judean Desert. Far from population centers, those may be the best sites this country ever could find.

At the same time, there seems to be a possibility for Israel to be at least partly independent of any outside nuclear fuel supply. Significant quantities of uranium are available in the phosphate rock mined here by the millions of tons; there also have been reports of economically feasible methods for its extraction from that source.

Many proponents of nuclear energy here now insist this country build such stations, even if negotiations for their purchase remain without result. Israel, it appears, already has an adequate supply of scientific and engineering manpower, to embark on such a project. Two research reactors have been working for more than two decades and there are also a number of Israelis who worked on such projects in other countries. Going it alone has its attractions, but most likely would exact a heavy economic price.

Whether all those proposals, possibilities and likely solutions to existing problems actually will result in a nuclear generating station in Israel, in the near future, remains an open question. Public opinion here is far from certain the likely benefits are worth the risk; as in other lands, here also atomic energy arouses deep seated atavistic fears, which may yet prove to be decisive.

CSO: 5100/4723

BRIEFS

NO HURRY ON AGREEMENT--President Shehu Shagari said in Lagos yesterday that Nigeria was not in a hurry to sign the "Nuclear Energy Safeguard Agreement" of the International Atomic Energy Agency (IAEA). He told the Director-General of the agency, Dr. Hans Blix, who paid him a courtesy call at the State House that Nigeria could not sign the agreement now 'because we have not developed anything". President Shagari, however, assured the Director-General of Nigeria's support for the agency in its efforts to promote safety in nuclear energy development. Alhaji Shehu deplored the role of some Western countries in aiding the development of neclear energy by the racist regime in South Africa. The situation now posed a threat to Africa and must be countered, he said. Earlier, Dr. Blix commended Nigeria for promoting disarmament and for signing the Non-Proliferiation Treaty. [Kaduna NEW NIGERIAN in English 19 May 82 p 16]

CSO: 5100/5673

NATION'S NUCLEAR POLICY DESCRIBED AS 'CALCULATED AMBIGUITY'

Johannesburg THE STAR in English 24 May 82 p 24

[Paul Moorcraft in "Counterpoint" column: "Irony Goes Nuclear"]

[Text] In an expanding world of nuclear weapons, man's history could become a short trudge from Adam to atom. If the nuclear powers ever rolled the cosmic dice, Darwin could be put into reverse; Mother Earth could become a planet of the apes again.

Maybe parts of the southern hemisphere could survive — Argentina, South Africa and Australia — if the atomic armageddon mushrooms over northern Europe.

Today the action is in the south, however. The battle for the Falklands is spearheaded by a Royal Navy which is nuclear armed.

As in 1914, the world could blunder into World War 3 despite or because of the present nuclear balance of terror. Six nations definitely possess the bomb, at least two others probably have it and by the 1990s perhaps a further 20 countries could grasp the nuclear nettle. And then add the mad-dog groups such as the Red Brigades or madmen like Gaddafi who are panting to steal or buy one ready made.

Will Pretoria join the nuclear weapons club, especially if the present six members become 26? The President's Council has advocated a De Gaulle presidency. The real De Gaulle used his presidential autocracy to forge ahead with a nuclear deterrent as a symbol of French will and independence. So after a Boer De Gaulle, an Afrikaner bomb?

Like Israel, South Africans could build the bomb. Pretoria has the technology and perhaps the incentive, although an open confession to having one would put the UN in a frenzy. The demand for comprehensive sanctions would be irresistible. And except for a massed Cuban-and Russian-backed invasion where would such a weapon be targeted? (Would a few A-bombs have helped Ian Smith?)

Even hints of a bomb have drawn rapid condemnation from both Russia and America. In 1977 they moaned to high heaven about a "test centre" in the Kalahari and in September 1979 when a Vela reconnaissance satellite detected a tell-tale double flash in the vicinity of South Africa.

To Pretoria such criticisms were just a flash in the scan and said it was all rubbish. But perhaps atomic testing is just like devaluation, you go on swearing you'll never do it — until you do so.

Pretoria's policy of calculated ambiguity over nuclear matters is impressive, especially compared with the main plank of its foreign policy, the intellectually constipated alliance of casino states. Pretoria has given just enough hints — perhaps the Kalahari "test" was intended to be discovered — to suggest that a South Africa with a bomb in the basement should be taken more seriously by the West. Pretoria could not have missed how the Nato powers were bewitched by the bomb-waving Charles de Gaulle in the 1960s.

Because men like Jimmy Kruger or Dr Munnik have not been allowed near the defence portfolio, NP politicians have not been bombastic about the bomb (if it exists). Heaven forbid that we should hear: "It would cost us only R20 a month each to be able to donder Moscow . . . The Russians are slow thinkers, you know . . . Their threats leave me cold . . . We would only shoot out a few windows in Moscow, etc., etc."

No, the cool, sophisticated, ambiguous denials have established precisely the correct ambience for an effective strategy of "deterrence by uncertainty."

But, in extremis, Pretoria might openly go nuclear; that is the eventual logic of the present garrison state mentality. Why shouldn't South Africa arm itself with the weapons that its enemies (and friends) flaunt with so much macho even though the UN would shout about the Republic's Masada complex

A South African bomb is no crazier than a French one.

Yet it is indeed a strange irony that the nations that fought an insane Hitler to the last bunker should come to rely upon a convoluted theory of deterrence which makes their survival (and everybody else's) dependent upon the rationality of all the future leaders (including the Amins) in all the increasing number of nuclear powers in the world.

Whether Pretoria joins the club or not, the Atomic Age is here to stay — but are we?

CSO: 5100/5669

WASTE PROBLEMS DETERRING FINNS FROM BUYING FRENCH N PLANTS

Helsinki SUOMEN KUVALEHTI in Finnish 4 May 82 pp 64-65

[Article by Mirja Bolgar: "Finland Interested in French Nuclear Power, But Not in Nuclear Waste"]

[Text] France's ambitious nuclear energy policy is already so firmly established that a change in governments or presidents is no able to change it to any perceptible degree. An illustrious history since the times of Joliot-Curie: the first patent for a French nuclear reactor was applied for in 1939, de Gaulle established the Atomic Energy Commission (CEA) in 1946, and now in 1982 there are 30 power plants in France and almost as many are under construction, 28.

Of these 30 reactors the majority is made up of presurized-water reactors either of the 1,300 or 900 megawatt type. The latter interests us Finns and it is being produced in France already on a series basis by Framatome, Alsthom-Atlantique, and Creusot-Loire. If the proportion of electricity produced by nuclear power plants is taken into consideration among the energy programs of the various nations, France is at this time number one: last year it produced 38 percent of its electricity in nuclear power plants (Finland 17 percent). It also received the lion's share of foreign orders for reactors, one more than Japan. The defects in previous models have been eliminated, the new models are in the opinion of the manufacturers more secure, and maintenance is easy.

France's nationwide network belongs traditionally to the nationalized electric company, EDF (Electricite de France), which works in cooperation with the Atomic Energy Commission (Commissariat de l'Energie Atomique). The joint engineering office of both these institutions, Sofratome, is at the present time conducting a study with Imatra Power on the feasibility of a 900-MW power plant (PWR) under Finland's conditions. Imatra Power is conducting a simultaneous study with the Soviet agency, Atomenergoeksport; the research phase will probably last until the end of the year and decisions will not be made until after it is completed.

Small Finland and big France are poor in raw materials for energy -- France does, indeed, have some uranium, coal, and gas, but it must still import the majority of its energy from foreign countries: a 130-billion franc "millstone" last year. Giscard d'Estaing's trip to Finland in the summer of 1980 gave impetus to the nuclear power project between our countries, and most probably it is was given additional hope during Francois Mitterand's short visit in April.

A Compromise for the Opponents

French plans experienced a slight setback last summer. The ecologists were promised before the elections that not everything will be placed in a dependency on nuclear power. Some power plant projects will be put on ice temporarily -- such as the Plogoff project in Bretagne, which had to be abandoned because of violent opposition from local farmers and fishermen.

The arguments of the ecologists: no power plants in densely populated areas, no large breeder reactors or treatment of radioactive waste -- "we do not want to be the world's trash can!". There are cleaner forms of energy such as the sun, forms that provide more employment such as coal; the wind and the ocean can be used for purposes other than guiding leaky oil tankers to the shores of Bretagne or sinking waste cylinders into the sea.

The government mobilized all its experts to study these protests and animated discussions were held in nationwide meetings. Nevertheless, in a surprisingly peaceful manner all the parties supported the use of nuclear energy with only slight differences in emphasis. The Socialist government, which has created its own Energy Ministry, was able to find a conciliatory solution to a delicate situation: the pace of construction was slowed down by one-third. For the time being, a green light is being given to three new power plants in a year; after this year new projects will be implemented according to the situation and need.

Conservation measures were also emphasized: the consumption of costly oil, which swallowed up nearly half of last year's total need, will be reduced to approximately one-third (70-75 MT) by the year 1990. The production of coal will be increased slightly for reasons of employment even though in the overall consumption of energy its proportion will decrease (to 15-16 percent). New sources of energy are being studied with rather modest results: in the year 1990 it will be only 4.5 percent of the total need, but over the long haul, after 20-25 years the picture will be quite different.

Even though gas will also be imported from the Soviet Union (a controversial project since evergy independence is a goal), it is expected that nuclear energy will unconditionally provide the most energy: in 1990 production will be more than threefold that of present production. France wants to be self-sufficient with respect to energy.

Waste Is a Problem

What kind of power plant do we Finns need? What will be done with the radioactive waste? To what degree can we ourselves participate in the construction of a power plant? Are we able to pay, is the equipment safe? I went to the CEA in Framatome and to the EDF to ask about these matters.

In CEA's information section I immediately presented them with the most delicate question: What will we do with the waste? If we purchase a French nuclear power plant, we will not be able to ship the waste on a train to the Soviet Union.

It is clear that the owner of a power plant also owns the waste, was the answer. We can have the waste retreated in France or vitrify, "encapsulate". it into cylinders -- I was shown miniature models, a substance what felt and in color looked like black obsidian -- then they are sent back to the owner country in stainless steel packages. (Smaller amounts of radioactive waste can be retreated in breeder reactors.)

The waste also becomes a part of the glass shell, and if the cylinder is buried deep into the ground, it dissolves and over a certain period of time it loses its excessive radioactivity, but this takes several decades.

Approximately 3 cubic meters of waste are accumulated annually from the operations of one 900-megawatt PWR power plant. If France is to treat the waste from Finnish power plants, naturally, a separate agreement must be concluded.

In Framatome's headquarters in the Defense skyscraper satellite, which is called the Manhattan of Paris, I met with commercial director Andre Touchard and press attache Marie Allozen.

Framatome was established in 1958 and it built the first Belgian-French unit in 1961 already.

[Question] What would be the Finnish share of the project if the reactor transaction becomes a reality?

[Answer] The skill and expertise of the engineers in Finland are of the highest level. This already became apparent from the questions they asked in the negotiations: they know what they are doing and what they need.

Since the feasability study is still in progress, I can only say what the Finns are asking of us. Imatra power is asking for a bid form Framatome on the nuclear portion of the reactor (NSSS = Nuclear Steam Supply System). Imatra Power has also asked Alsthom-Atlantique to submit a bid on certain conventional portions of the equipment (turbines, among other things). It is awaiting a bid on the fission material from Cogema and on the fuel from Framatome. Thus Finland is not purchasing a complete power plant from France, only those components which the Finns themselves cannot build.

Thus Finland's own share would be significant. Imatra Power is inquiring into corresponding components from us, components that it once purchased from the Soviet Union (Loviisa); since it has been able to build the remainder of the equipment on its own, it will, naturally, not expect the French to do this. But negotiations are also being conducted with France on specialists needed to install the NSSS.

[Question] Does France have any experience in these types of transactions?

[Answer] We have sold 900-MW pressurized-water vessels to Belgium, complete power plants to Korea as well as to South Africa and Iran even though the latter transaction did not go well due to political reasons. We have also been requested to sell two NSSS to Taiwan.

[Question] Are your prices competitive?

[Answer] In Belgium we competed with the Americans and the Germans. As far as quality is concerned our prices were competitive. Of course, in making an evaluation the operational time must be taken into consideration (for example, in the first year 5,000 hours, in the second year 6,000, and so on). Economic experts calculate the life span of a reactor to be approximately 25 years, but pressure vessels have been designed for 40 years.

[Question] And a guarantee?

[Answer] The assembly guarantee is, of course, shorter. We will guarantee our own calculations; a guarantee for the whole system is, of course, always shorter. Only a year or more. This can be negotiated.

[Question] What about maintenance?

[Answer] France is prepared to undertake this for years. We are continuously manufacturing tools and instruments for inspecting power plants, finding and correcting defects. We are prepared to provide services for all countries which purchase Framatome's reactors. Of course, the builder himself knows best how to correct defects.

[Question] Are you optimistic about France's nuclear future?

[Answer] Yes, we want to succeed.

Examples From Imatra Power

What was the situation in EDF? There I presented questions to Maurice Magnien, director of the research section. He had a considerable amount of positive experience in cooperation with the Finns in the development of our electricity network from 30 years ago already. "When I go to Finland, it is like going home," he states.

"It is normal that Finland turned to France in issues concerning nuclear energy. The Finns understand the background and the history of this issue; we have now reached a stage of maturity, we have scientific-technical competency, an ability to convert uranium into fuel, and more than 10 years of experience in present pressurized-water reactors.

The Finns are seeking from France a different type of reactor knowledge than they already have. They already have a firm understanding of a nuclear energy future on the basis of the Soviet-type power plant in Loviisa and the Swedish-type power plant in Olkiluoto. We place much value on this cooperation for the reason that the Finns are so well informed on these issues.

"The Finns will be able to receive information concerning the construction of reactors and general and detailed research materials from us. We can also compare French and Finnish safety standards and deliver to Finland the special equipment it will need. Just as two automobiles drive differently, there are differences in the operations of reactors; wear, expenditures, maintenance, regular inspections, and so on depend on them."

[Question] Do Finland's strict safety standards correspond to French standards?

[Answer] In the long period of France's atomic history there has not yet been one single accident. The small crack in the Fessenheim Power Plant was repaired and it did not cause any harm to the environment. The reactor is once again operating safely.

The double feeding of fuel has been found to be satisfactory in France. If precautionary measures and emergency channels are increased, prices will, of course, increase somewhat. Finland intends to obtain three feeding mechanisms -- if one fails, there will be two in reserve. Nothing according to my understanding will stand in the way of this objective. There are countries which have even requested quadruple systems.

In the price calculations for electricity Director Magnien assumes a life span of 30 years for a power plant. One nuclear energy kilowatt will thus cost a producer 18 centimes, with coal it would be double. Electricity produced by oil is the most expensive, a full 55-60 centimes.

He also stated that the French intend to benefit from Finnish experience, for example, in heat conservation. Imatra Power's decision to gradually abandon oil in its entirety in some areas, for example, in the heating of housing units is exemplary.

Director Magnien still considers coal to be an interesting source of energy: it can be converted, refined, purified; its use should be considered from a completely new point of view and its "clean" usage possibilities should be thoroughly studied.

Nevertheless, in his opinion the future belongs to electricity. The high level of employment can also be considered as one of the benefits of nuclear electricity: In France the power plants employ 150,000 people above and beyond EDF's own personnel.

[Question] Does France have good market prospects at this time?

[Answer] Negotiations are being conducted with Mexico and Egypt, among other countries. I myself believe that in 20-30 years nuclear power plants will be sold just as easily as automobiles are being sold today.

10576
CSO: 5100/2173

NO FUNDS SEEN FOR HIGH TEMPERATURE REACTOR

Frankfurt/Main FRANKFURTER RUNDSCHAU in German 27 May 82 p5

[Article by "gs": "No Chance for High Temperature Reactor, Buelow Says"]

[Text] Bonn—Federal research minister Andreas von Buelow (SPD) told the cabinet on Wednesday that construction on the high temperature reactor (HTR) at Schmehausen in North Rhine-Westphalia would be halted by the end of June unless new funds were found until then. "We are unable to build" both reactor types—the HTR and the fast breeder—at the same time, von Buelow said, adding that he could not call a "halt to research policy" for the next 5 years just to be able to pay for the two reactors. In justifying his preliminary decision against the HTR and in favor of the fast breeder, the research minister said that research policy decisions must also take the needs of the business sector into account.

The North Rhine-Westphalian economics minister Jochimsen (SPD) who is contributing to the HTR funding sees it much the same way. "North Rhine-Westphalia is not in a position to finance a state reactor against the opposition of the rest of the world—a reactor nobody wants," Jochimsen told the research committee in Bonn on Wednesday. North Rhine Westphalia did not come out in favor of the HTR simply because it is good for refining coal, he said. In contrast to other reactors, the HTR offers "surplus security."

In all likelihood, the research minister will have to recommend to the cabinet in 4 to 5 weeks that construction be halted, since he sees no hope of closing the DM 1.5 billion gap with the help of regular budget funds, money from the business sector, a research tax or a "nuclear penny" to be added to home electric bills. In view of the "unresolved cost picture," von Buelow told the cabinet, he did not release the DM 298 million instalment due in early April to enable the HTR construction program to continue. On 22 March, he said, the HTR consortium had informed him that there was likely to be a DM 1.1 billion overrun on the reactor budgeted for DM 3 billion. This sum includes DM 400 million in the form of a risk surcharge based on the "indeterminate outcome of the ongoing approval procedures."

He had thereupon been told by the finance minister, von Buelow said, that no guaranteed government loans to fund the HTR could be approved because of the open-ended nature of the total costs. As a consequence, von Buelow said, there is a DM 1.5 billion shortfall in funding the project.

According to the research minister, DM 1.7 billion have already been paid out and another DM 2 billion have been committed for the HTR project. Calling a halt to construction was not likely to cost more than the DM 2 billion already approved. The federal government is to contribute 57 percent of the DM 3 billion total costs for the HTR, with North Rhine-Westphalia contributing 10 percent; the operators of the facility, 3 percent and the producers, 4 percent. Investment allowances are to make up 9 percent and loans 17 percent of the total.

Von Buelow and Jochimsen had a meeting last Monday with representatives of Ruhrkohle AG, Ruhrgas AG, the electrical industry and the chemical industry concerns of Bayer, Hoechst, BASF and the Huels chemical works concerning the utilization and funding of the HTR. Von Buelow said he could detect "sympathy" on the part of the business representatives for the HTR but no new financial commitment. For the coal and gas industry, von Buelow said, the HTR which not only is capable of producing electricity but heat may be of help "in the long run"—perhaps in "15 or 20 years"—in the gasification of coal. The power industry, for its part, thought that the HTR was of no real use at this time in the production of electricity alongside the light-water reactor. The electrical industry is in fact pinning its hopes on the fast breeder, von Buelow said.

Meantime, the research minister also expects "rather sizable cost overruns" for the breeder. The total cost estimate of DM 5 billion for the breeder was arrived at, he said, by assuming "very favorable" delivery and approval schedules. Negotiations with producers and operators on covering cost overruns are already underway. The operators themselves are by now talking in terms of total costs in the DM 5.5 billion to DM 6 billion range.

In response to a query by FRANKFURTER RUNDSCHAU, Ulrich Steger, the energy expert of the SPD fraction, said the von Buelow decision against the HTR and in favor of the breeder would not be approved by a majority of the SPD and FDP Bundestag fractions. The wishes of the electric industry should not, so Steger said, "determine the course of research policy."

9478
CSO: 5100/2188

SODIUM FIRES CAUSE INDEFINITE PHENIX SHUTDOWN

Paris LE MONDE in French 4 May 82 p 48

> [Text] The prototype Phenix nuclear power station, on the grounds of the Marcoule nuclear studies center (Gard), has been shut down since Thursday 29 April for a still undetermined period. Two incidents 24 hours apart, though "without radiological consequences to the environment," have affected operation of the 250 megawatt power breeder reactor station, and led the operators to put the plant in "security configuration."

The first incident occurred Thursday evening. Like the second, it took place in one of the station's three steam generators, in which circulates hot sodium totally inactive radiologically. There that sodium, called secondary to distinguish it from the primary sodium whose function is to evacuate the calories produced in the reactor core, heats water to produce the steam needed to activate the turbo-alternator which produces the electricity for the net. Though sodium is particularly well suited to the needs of this type of reactor, of which the 1200-megawatt Super-Phenix station under construction is the industrial prototype, it has the disadvantage of reacting violently with air and water.

That is exactly what happened with Phenix. When checks were made of the sodium content of the secondary circuit, the station's operators noted an abnormal hydrogen count--a characteristic of chemical reaction between sodium and water. The reactor was immediately stopped, and the steam generator in which there was a leak was drained and put in a security configuration.

Twenty four hours later, for reasons still unknown to the investigators, a valve in the same steam generator in turn began to leak, freeing a few liters of sodium which immediately caught fire on contact with air. The fire was quickly brought under control by a powdered extinguisher (Mercalina) perfected by teams from the AEC and CNRS Orleans center for study of combustion and high temperature chemistry (LE MONDE, 14 April).

Although rare, this type of incident is not unusual, and there have been a few past alerts of this kind at the Phenix station, which was put in operation in 1973 as a test unit for the chain of breeder reactors. In 1974, for example, there were sodium leaks, and in 1976 a sodium fire in the intermediate heat exchangers of the reactor. That problem led, however, to modification of the assembly.

Thus Thursday's and Friday's events, in their safety aspects, are not such as to cause undue alarm to the AEC teams, who point out, moreover, that the faulty steam generator had functioned without problems for almost 10 years.

6145
CSO: 5100/2165

ANTI-NUCLEAR MARCHERS DEMAND SUPER-PHENIX SHUTDOWN

Paris LE MONDE in French 4 May 82 p 48

[Article by Marc Ambroise-Rendu: "For a Life Without Plutonium"]

[Text] Wearing jeans and basketball shoes, with placards on their chests and streamers in hand, the anti-nuclear marchers who left Malville 3 weeks ago entered the capital on Saturday 17 April. A wager made good.

They have hardly changed since that July day in 1977 when through rain and clouds of tear gas they tried to pierce the lines of security police defending the breeder reactor building site. They are 5 years older, but they are still the same headstrong idealists dreaming of a plutonium-free society. Super-Phenix will produce its first kilowatt-hours next year. For their part, they march, boys and girls, young and old, a thin cohort of dissident pilgrims, barefoot innocents denying the evident and preaching refusal.

They were 40,000 at Malville in Giscard's time, and today 40,000 of them have set out to meet the head of state. He is in Japan; the militants are demobilized; and French Electricity and the Atomic Energy Commission are shipping cargoes of journalists to Cadarache and Malville to demonstrate that the breeder reactor is the safest and most esthetic of megamachines. No matter--they march as others kneel.

Since the start, the same scenario has recurred a score of times. In the lead, a sound vehicle harangues the villagers; in the rear, the service van picks up the footsore; in between, the squad of marchers advances at 5 km an hour, handing out tracts to bystanders. Each evening at the halt, under the eyes of debonair and often interested gendarmes, a militant tosses into a basin a few grams of sodium, the substance which in quantities of several thousand tons will cool the bowels of the breeder reactor.

It looks like a bit of butter with the color of aluminum, and flares up prettily with a puff of white smoke: that is what awaits you, good people, if the Super-Phenix weld joints have weaknesses. Then, in the village hall, to a few dozen viewers, are shown audiovisuals on the breeder reactor and on alternative proposals by opponents of nuclear power. There are discussions, explanations, and challenges to local Socialist office holders, who often admit their embarrassment.

But what in the world are these tireless people asking? "First, an immediate halt to the building of Super-Phenix--in short, a moratorium," they explain. "Plutonium remains active for tens of thousands of years. We can surely give a few months to serious thought about it. We must take the time to organize the true democratic debate which has been denied us. Then the French people will be able to choose between our energy proposals and the nuclear program the government stubbornly pursues. With the breeder reactor, nuclear energy is not the transitional energy we hear about; it is a long-term choice which practically excludes all others."

"Anesthesized"

How has that speech been received along the way? "People receive us and listen with sympathy," the marchers note. "They know hardly more than 5 years ago, even the office holders. But they seem to be anesthesized. Nuclear power today is routinized. It is considered inevitable. We are here to awaken opinion and undeceive it. The problems we have been bringing up for years are still present. They will rise again with the first accident."

The marchers everywhere slept in local homes. They were received and assisted by many municipalities. To pilgrims the law of hospitality still applies. But did they convince? In any event, they collected thousands of signatures on postcards, addressed to the president, asking him to stop Super-Phenix. He will receive over 100,000 of them. But will he receive the marchers themselves? They will appear before the Elysee for the first time on Sunday (did they know the president was away?). If the gates are not opened, a delegation will present itself each month for as long as necessary. "As long as the nuclear program continues," they say, "the anti-nuclear struggle will continue."

6145
CSO: 5100/2165

DEFECTIVE STEEL IN BOLTS HALTS FORSMARK NUCLEAR REACTOR

Seven Hundred Bolts Involved

Stockholm SVENSKA DAGBLADET in Swedish 2 Jun 82 p 6

[Article by Dag Bjerke: "Cracked Bolts Stop Reactor"]

> [Text] Two hundred forty of a total of 700 bolts in the fuel core of the second reactor at Forsmark are cracked. All the bolts must be replaced, which means that the present work stoppage will be extended by almost 2 months.

The same problem is probably going to arise when Forsmark I is shut down for routine inspection in a few months. That reactor has the same type of unfortunate bolts as the nuclear power station built by Asea-Atom in Raumo, Finland, on the other side of the Bothnian Sea.

When the technicians of Asea-Atom constructed these reactors in the 1970's, overambitious computer calculations predicted strong vibrations during start and stop. To protect against these difficulties it was considered necessary to use best quality bolts to secure the control rods on the inside of the core grating cavity.

Tightened Hard

Therefore bolts of extra-strength stainless steel were chosen, which are surely completely adequate under normal circumstances. But under strong tension, for example if the bolts are tightened too hard, in combination with the presence of hot water, the material apparently becomes affected with something called tension corrosion.

The exact nature of this kind of corrosion is not entirely known, but it is known that the condition must have tension and moisture at the same time. If only one of these components is present, the steel remains corrosion-free and strong.

In older reactors, where such sophisticated material has not been used, corresponding problems have not arisen.

Heads Stuck Out

The defective bolts were discovered on 19 May when a fuel element was being lifted out of the core. The element was caught on a bolt head, which was normally countersunk, which stuck out from the control rod and thereby prevented a lip on the fuel element from passing upward.

The bolt in question had therefore broken. It was removed from its radioactive environment by using a remote manipulator. The entire core lay under 20 meters of radiation shielding water.

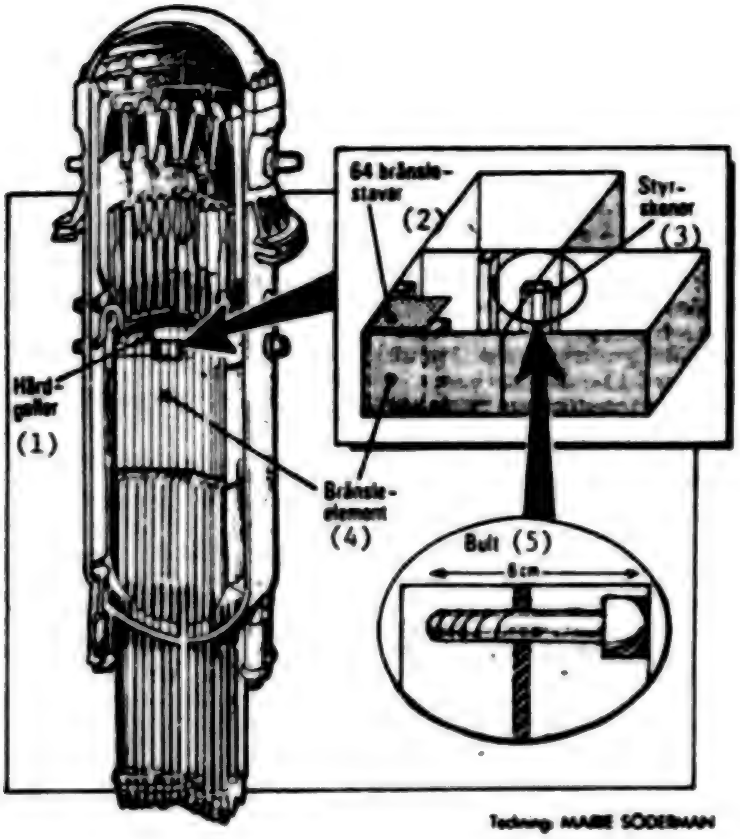
During the work which takes place in connection with annual maintenance, the cover of the reactor tank and all interior details above the core grating are lifted away.

About 250,000 Kronor Per Day

For about the next 2 months, which in terms of lost energy deliveries amounts to 200,000 - 300,000 kronor per day, it will now be necessary to lift up the entire radioactive grating and with manipulators install 700 new bolts of a more suitable material.

It is difficult to see any direct safety risk in this circumstance. The problem is more nearly one of operational technique. It is difficult (or impossible) to take out old expended fuel elements and replace them with new when refuelling the reactor.

[Diagram and caption on following page.]



Teckning: MARIE SÖDERMAN

Key: (1) Core grating
(2) 64 fuel rods
(3) Control rods
(4) Fuel element
(5) Bolt

Caption: The defective bolts of high-strength stainless steel hold the control rods in the four corners of the core grating square. These rods in turn hold the four fuel elements (each containing 64 uranium fuel rods) in each corner of the square space.

The control rods ensure that a cruciform interval is maintained between the elements, which the control rods, regulating reactor power, can be inserted into or withdrawn from. The bolt heads are countersunk in the control rods so that the lip on the fuel element (not shown in the diagram), passing out by the control rod will not be stopped when removing the old fuel element and inserting the new.

New Steel Material Being Studied

Stockholm DAGENS NYHETER in Swedish 5 Jun 82 p 31

[Article by Ingemar Lofgren: "The Steel Did Not Measure Up And Therefore The Bolts Cracked"]

> [Text] Asea-Atom is searching for a new steel for the bolts and spring beams which cracked in the four reactors at Forsmark and Finnish Olkilouto. The high-strength steel did not measure up. "We are now going back to an older type of material," said Per Faxer, financial manager of Asea-Atom.

"Our technicians are very busy finding a suitable material for new bolts and beams. We do not know how long it will take, but we must do careful testing and calculate the possible costs," said Per Faxer to DAGENS NYHETER.

A couple of weeks ago it was discovered that reactor bolts in Forsmark 1 and 2 and Olkilouto 1 and 2 in Finland had cracked from so-called tension corrosion. They had been tightened too hard.

Cracked Beams

The purpose of the bolts is to hold the fuel rods in place in the reactor, and there are 700 bolts in each reactor.

When the faulty bolts were investigated it was discovered that the spring beams were also cracked. The 1.5 meter long beams are located under the reactor cover, and their purpose is to hold the moisture trap and separators in position. In each reactor there are eight tightly fastened spring beams.

The four reactors in Forsmark and Olkilouto are the same model and built by Asea-Atom. Altogether it is a question of 2,800 bolts and 32 spring beams which must be replaced--all made of high quality stainless steel type 2570. The steel was chosen especially before the construction of Forsmark when Asea-Atom was bringing in a new reactor construction.

The firm believed that there was great risk of strong vibrations, and therefore chose a high-strength material for the bolts and beams.

Everything was fine until the cracks were discovered.

"We have not been so knowledgeable about tension corrosion, but now we have learned a little more. We now know that there is not so much vibration and that neither the bolts nor the beams need to be so tightly fastened. We will therefore go back to the original and proved material which we used previously," said Faxer.

The cracks in the spring beams are, in comparison with the defective bolts, relatively undramatic, according to both the firm and the nuclear power inspectors. They are easier to replace and will not affect the difficult work with the bolts.

In Sweden Forsmark 2 has already been stopped for inspection. Forsmark 1 will be stopped in the middle of July.

All the bolts and beams are expected to be replaced by the beginning of August.

9287
CSO: 5100/2186

LOSS OF HOPED-FOR MEXICO ORDER MAY BE FATAL TO NUCLEAR FIRM

Stockholm SVENSKA DAGBLADET in Swedish 16 May 82 p 14

[Article by Karin Henriksson]

[Text] Is little Asea Atom strong enough to win the Mexican order for nuclear power plants?

The lobbying is over and the bids are in and the seven competing nuclear firms can only wait.

The order is important for Asea Atom, which has no further prospects on the Swedish market. As SVENSKA DAGBLADET reported yesterday, it looks like Asea Atom will be a wholly owned subsidiary of Asea, since the state is prepared to sell its half. One reason for this transaction is that Asea wants to retain the skilled personnel within the company, even though the nuclear power market is slumping--but this does not mean that Asea Atom has given up hope in Mexico.

A decision on who will receive the coveted order worth up to 150 billion kronor will not be made until early fall after a new president takes over.

Reports that Mexico, which is experiencing economic difficulties since oil revenues began to decline, would be forced to cut back on its extensive plans for nuclear power have been denied vigorously. The recent decision by the Mexican government to reduce public expenditures by 3 percent annually will not affect these plans, according to a spokesman at the Mexican Embassy in Sweden. "This will be guaranteed by expansion in the oil and mining sectors," he said.

"According to our information, the project will proceed as planned. We may assume that price and financing will become all the more important in their decision, however," said Arto Kaipainen, information director at Asea Atom.

Secret

The secrecy around this politically charged transaction has been extensive, both on the part of the Mexican authorities and the seven nuclear firms that submitted bids in sealed envelopes on 1 February this year. Asea Atom's technical information alone required 24 standard size folders. Also submitted was the envelope in which Asea Atom, with the government's blessing, revealed the price which is based on unknown hundreds of millions in export credit.

Mexico is suffering from an electricity shortage today, but according to plans at the end of this century nuclear power plants will generate 20,000 MW annually. That is equal to one fifth of the present nuclear capacity in the world.

The value of the entire order is estimated at 140 to 150 billion kronor. In addition to 20 reactors, it includes fuel production, waste handling, administrative advice, etc. The construction site is on the Atlantic coast in Laguna Verde near the port city Veracruz. There is already a 1,300 MW nuclear power plant there which General Electric has been building off and on since 1973.

Technological Prestige

The country that lands the Mexican order will save tens of thousands of jobs and uphold its technological prestige.

There has been a steady stream of suitors to President Jose Lopez Portillo in Mexico City. French President Mitterrand visited Mexico City on his first visit abroad as president in October and 2 months later a special envoy arrived from President Reagan of the United States. The most frequent visitor has been Prime Minister Pierre Trudeau of Canada and the Canadian Candu reactor was seen as the favorite in the first round of bidding.

After Trudeau's most recent visit, his portrait had hardly been removed from the parade route when King Carl Gustaf arrived with an elite delegation from Swedish industry.

The second favorite is France and this is not so much because the French nuclear industry is superior to the others as it is because the French tend to ignore the rules of international financing.

After all, Mexico must be given favorable financial arrangements if the purchase is to take place at all.

Normally it is against American principles to extend this type of credit, but when Reagan's envoy visited Mexico it became clear that the American government was willing to negotiate special conditions in this case. One factor making a deal with the Americans less likely is that Mexico already is about 70 percent dependent on trade with its powerful neighbor to the north. Mexico wants to reduce this dependence and on various visits Canada, France, and Sweden have stressed their willingness to strengthen friendly relations with the Mexicans.

Phase 1, included in the first round of bidding, is worth at least 10 billion kronor, of which half shall be spent in the nuclear power company's own country. Seven firms in five countries are involved in the battle: the United States (General Electric, Westinghouse, Combustion Engineering), Canada (Atomic Energy of Canada), West Germany (KWU), France (Framatome), and Sweden (Asea Atom).

Asea Atom is a dwarf in these circles, but enjoys an extremely good reputation with its Swedish purchaser--i.e. the State Power Board.

"Asea Atom's knowledge and experience are beyond question. Of course, it is difficult to make simple comparisons of nuclear firms, but Asea Atom has both sound technology and good fuel," said a spokesman at the State Power Board.

Asea Atom (which at the moment is owned half by Asea and half by the state) has built nine reactors and two others are under construction. Two of the reactors, TVO 1 and TVO 2, are in Finland. Asea Atom's reactors are boiling water reactors. Forsmark 3, which is the reference facility in the Mexican bid, will be complete in 1985.

General Electric (boiling water reactors) has manufactured most of the reactors used in the United States. GE also has exported reactors to Spain, Italy, and Mexico and worked together with AEG of West Germany. GE reactors are manufactured under license in Japan.

Largest Company

Westinghouse, which is the largest nuclear power company in the world, had 109 reactors operating in 1979, in addition to 53 manufactured under license. Westinghouse fuel and equipment has been sold to nine countries and the company hopes to triple the number of Westinghouse plants during the next 10 years. Westinghouse pressurized water reactors have experienced problems recently, however. Ringhals 3 has been restarted at half-power after being down since October last year and, for this reason, many are awaiting the outcome of the legal battle that may be expected between Westinghouse and the State Power Board.

Combustion Engineering (pressurized water reactors) had constructed 10 reactors by 1981 and eight units are under construction for completion in 1983 to 1985. All are in the United States.

Atomic Energy of Canada, AECL, constructed its first reactor in 1962 and by 1985 to 1986 it will have completed 15 reactors of 16,700 MW. The AECL heavy water reactor is found mainly in Canada, but also in Argentina, South Korea, Pakistan, and India. Uranium for the heavy water reactor need not be shipped to the United States or France for enrichment, as is the case with competitive fuel types, but even though Mexico has large uranium reserves, it would be dependent on Canada to deliver heavy water.

Broad Program

By 1981 KWU, Kraftwerk Union (pressurized water reactors), had constructed 30 reactors--one each in Switzerland, the Netherlands, and Austria, two each in Spain, Argentina, and Brazil. The rest are located in West Germany. KWU has a broad energy program including natural gas, coal, and petroleum technology, in addition to nuclear expertise.

Framatome (pressurized water reactors under license from Westinghouse, in addition to independently developed reactors) has 51 reactors complete or under construction. Most are in France, but seven were sold for export to South Africa (2), South Korea (2), and Belgium (3).

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